

Guidelines for developing adaptive management plans in Yukon

Water-related components of quartz mining projects

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Acknowledgements and document history

This document was originally drafted in 2017 by SLR Global Environmental Solutions under contract with the Government of Yukon. In 2019, the document was updated and revised by Gomm Environmental Engineering, Slater Environmental Consulting, and Government of Yukon departments.

About this document

In 2014, the Yukon Water Strategy and Action Plan was released, identifying goals and actions in six priority areas. “Promote the sustainable use of water” was one of these priority areas. It included the action to “engage with water users to ensure they understand the relevant legislation and regulation and, if applicable, licences and permits related to their activity.” As a result, this document was developed to assist quartz mining applicants or licensees in understanding and developing Adaptive Management Plans, in accordance with Quartz Mining Licence and Water Licence requirements.

The guide is a living document, and will be reviewed and updated within three years to accommodate changes in management approaches and legislation. Please send any comments, questions or feedback to Water Resources Branch at water.resources@gov.yk.ca.

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Table of contents

About this document	i
Authors, reviewers and contributors	i
Endorsed by	i
Table of contents	ii
List of figures.....	iv
List of abbreviations.....	iv
Glossary of terms.....	v
Executive summary.....	vii
What is adaptive management?.....	vii
Structure of the guide.....	vii
1.0 Introduction	1
1.1 Purpose and scope of this guide	1
1.2 Regulatory context in Yukon.....	1
2.0 Adaptive management	4
2.1 Adaptive management theory	4
2.2 Adaptive management plans	4
3.0 The AMP process and required components	7
3.1 Conceptual adaptive management plans	7
3.2 Comprehensive adaptive management plans.....	8
3.2.1 Project context	8
3.2.2 AMP approach.....	8
3.2.3 List of AMIs.....	8
3.2.3.1 Description of specific adaptive management initiatives.....	9
3.2.3.2 Narrative response	10
3.2.3.3 Indicators	10
3.2.3.4 Triggers and action levels	10
3.2.3.5 Monitoring requirements	15
3.2.3.6 Evaluation of monitoring results	15
3.2.3.7 Development and Implementation of management response plans	16
3.2.3.8 AMI reporting	20
3.3 AMP annual review, reporting and updating	20
3.4 Consultation and engagement plan	21
4.0 Modifications to AMP for abandoned sites or sites requiring staged mitigations	24



References cited.....	26
Appendix 1 – Sample AMP table of contents	27
Appendix 2 – Examples of adaptive management initiatives	28
2.1 Adaptive management initiative (AMI) example 1 – xyz pit water level	28
2.1.1 Description of specific AMI.....	28
2.1.1 Narrative response.....	28
2.1.2 Indicators.....	28
2.1.3 Trigger and action levels	29
2.1.4 Monitoring requirements.....	30
2.1.5 Evaluation of monitoring results.....	30
2.1.6 Development and implementation of management response plan development.....	30
2.1.7 Reporting requirements	32
2.2 Adaptive management initiative (AMI) example 2 – xyz pit water level	32
2.2.1 Description of specific AMI.....	32
2.1.1 Narrative response.....	33
2.1.2 Indicators.....	33
2.1.3 Triggers and action levels.....	33
2.1.4 Monitoring requirements.....	35
2.1.5 Evaluation of monitoring results.....	35
2.1.6 Development and implementation of management response plan development.....	36
2.1.7 Reporting requirements	37
2.3 Adaptive management initiative (AMI) example 3 – groundwater quality down gradient of xyz waste rock dump	38
2.3.1 Description of specific AMI.....	38
2.1.1 Narrative response.....	39
2.1.2 Indicators.....	39
2.1.3 Triggers and action levels	39
2.1.4 Monitoring requirements.....	40
2.1.5 Evaluation of monitoring results.....	41
2.1.6 Approach to management response plan development.....	41
2.1.7 Reporting requirements	43
Appendix 3 – Definition of significance thresholds for water quality based on water quality objectives	44
Appendix 4 – Examples of action level triggers for water quality in the receiving environment	46
Appendix 5 – Examples of action level triggers for groundwater	48



List of figures

Figure 1 A description of where AMP development fits in the mine lifecycle process.	3
Figure 2 The AMP describes an approach that uses management response plans (MRPs) to develop, monitor, evaluate, report and adjust.	6
Figure 3 Expected contents of a comprehensive AMP.	9
Figure 4a and 4b Example of relationship between significance threshold, action levels and triggers for water level/quantity.	12
Table 1 Description of Low, Moderate and High Action Levels	12
Table 2 Management Responses to Low, Moderate and High Action Levels.	19
Table 3 Potential consultation and engagement activities to be carried under the AMP	22
Table 4 Description of Low, Moderate and High Action Levels for Staged Mitigations	25
Table 6 Staged Response to Trigger Activation.....	31
Table 7 Description of Low, Moderate and High Action Levels	34
Table 8 Staged Response to Trigger Activation.....	36
Table 9 Description of Groundwater Quality Low, Moderate and High Action Levels	40
Table 10 Staged Response to Trigger Activation.....	42
Table 11: Description of Surface Water Quality Significance Thresholds for Parameters with Water Quality Objectives.....	44
Table 12: Description of Example Surface Water Quality Significance Thresholds and Action Levels	46
Table 13 Action Triggers for Groundwater.....	48

List of abbreviations

AM: Adaptive Management
AMI: Adaptive Management Initiatives
AMP: Adaptive Management Plan
BCMOE: British Columbia Ministry of Environment
CCME: Canadian Council of Ministers of the Environment
COPC: Contaminant of Potential Concern
EQS: Effluent Quality Standard
MRP: Management Response Plan
UCLM: Upper Confidence Limit Mean
WQG: Water Quality Guideline
WQO: Water Quality Objective
YESAA: Yukon Environmental and Socio-economic Assessment Act



Glossary of terms

Action Level: A level of environmental change that triggers action under the Adaptive Management Plan.

Adaptive Management: The process of planning a response to circumstances or events that may not be fully predictable or expected. Adaptive management identifies, in advance, actions that must be taken to gather information and respond appropriately in the event of an unanticipated or unpredictable circumstance.

Adaptive Management Initiative (AMI): A specific condition that is anticipated to require monitoring, assessment and management as part of the adaptive management plan.

Background Concentration Procedure (BCP): A method for developing water quality objectives that are based on the natural background concentrations of contaminants of potential concern in water, as determined through implementation of a baseline monitoring program.

Contaminant of Potential Concern (COPC): A substance that a project may release into surface and/or groundwater at concentrations that may hinder achievement of water quality objectives.

Indicator: An environmental component or parameter to be monitored and assessed as part of the Adaptive Management Plan.

Management Response Plan (MRP): A document that describes the planned mitigation and management actions to be taken in response to an action level or trigger being reached.

Precautionary Principle: Consideration of potential impacts, prior to making management decisions. This provides a mechanism to exercise caution when potential environmental risks are identified and to implement an adequate response before a significant environmental impact occurs.

Receiving environment: Surface water or groundwater into which site drainage or effluent is discharged, directly or indirectly.

Significance Threshold: The threshold where environmental change would be considered significantly adverse. Thresholds should be based on predetermined benchmarks based on specific parameters and processes of the project.

Trigger: A threshold (numerical value) and/or a trend (tendency in numerical values) that if reached will result in the initiation of a specific action or management response.

Different triggers will have different levels of action, ranging from simple to complex.

Traditional Knowledge: This is to be defined by individual First Nations governments. Many First Nations governments have protocols on how best this information can be shared. Also commonly referred to as Indigenous ways of knowing

Water Quality Guidelines (WQGs): Benchmarks established by a government agency, such as CCME or BCMOE, that indicate levels of physical, biological, or chemical parameters for the protection of a water use, such as aquatic life, wildlife, agriculture, drinking water, or recreation.

Water Quality Objective (WQO): Narrative and/or numerical definitions of acceptable water quality conditions in specific receiving waters and/or on water on or adjacent to settlement lands that may be affected by a project.



Executive summary

This document (the “guide”) provides guidance to quartz mining applicants and licensees on how to develop and apply Adaptive Management Plans (AMPs) for water quality and quantity at quartz mining sites. The guide provides an approach to help applicants or licensees meet the AMP requirements of Quartz Mining Licenses and Water Licenses, which stem from the Quartz Mining Act and Waters Act. As well, Yukon and First Nation governments and agencies, stakeholders, and the public can use the guide to learn about AMPs and their application to water.

What is adaptive management?

Adaptive management is the process of planning a response to circumstances or events that may not be fully predictable or expected. Adaptive management identifies, in advance, actions to take in order to gather information and respond appropriately in the event of an unanticipated or unpredictable circumstance.

Structure of the guide

1. Introduction – this section describes the purpose and intended audience of the guide, why AMPs are important and regulations that apply to AMPs.
2. Adaptive management plan approach – this section describes the theory of adaptive management and provides background and contextual information.
3. The AMP process and required components – this section provides a detailed description of all the components that are expected in an AMP.
4. Modifications to adaptive management plan elements for staged mitigations – this section presents specifically how to develop an AMP for projects that require staged mitigations (at an unknown timeline).
5. Appendices – this section includes specific examples and details including examples and a Table of Contents for an AMP.

Guidelines for Developing Adaptive Management Plans in Yukon

WATER RELATED COMPONENTS OF QUARTZ MINING PROJECTS

This guide provides technical guidance on the approaches and process of developing Adaptive Management Plans (AMPs) for water-related components of quartz mining projects in Yukon. Specifically, the Guide describes components of an AMP, and supports proponents in developing various responses to different changes in water quality and quantity.

There are three phases of AMPs outlined in this guide:

Conceptual AMPs

Comprehensive AMPs

Updated AMPs

It is recommended that proponents develop all three. Comprehensive AMPs are the most rigorous, with many necessary components. Key components include:

Key components:

PROJECT CONTEXT An overview of the mine site, environmental monitoring program, and regulatory context.

AMP OBJECTIVES AND SCOPE A description of the AMP goals, objectives, and approach that includes outlining the plan's adaptive management initiatives (AMIs).

LIST OF ADAPTIVE MANAGEMENT INITIATIVES The AMP should have a list of the individual AMIs that are covered in the AMP. Each individual AMI should then be detailed with the following elements:

Adaptive Management Initiatives

NARRATIVE RESPONSE

A narrative description of the response for the AMI, which leads to the development of the specific indicator and thresholds

DESCRIPTION OF SPECIFIC AMI

A description of the specific event or condition that is being addressed and includes the potential effect that needs to be avoided.

INDICATORS

An environmental parameter that is actively monitored. The indicator(s) identify(ies) when a specific type of unacceptable condition is occurring or is predicted to occur.

TRIGGERS AND ACTION LEVELS

A numerical value for an indicator which, when reached, signals that a management response is required. Proponents should develop triggers for each indicator, as well as associated action levels for each trigger that is reached

EVALUATION OF MONITORING RESULTS

Description of the methods and frequency in which monitoring data will be evaluated to determine if/when a trigger has been reached.

MONITORING REQUIREMENTS

Monitoring that will occur for each indicator. Monitoring is conducted as per the Monitoring and Reporting Plan

MANAGEMENT RESPONSE PLANS (MRP)

Description of the overall approach, development and expected content of MRPs. Provide possible management responses that range in intervention or mitigation requirements

AMI REPORTING

Description of the methods and frequency in which reporting will occur for each AMI, should a trigger be reached. AMI reports should include information of the implementation of the MRP and its impacts on the indicator.

AMP REVIEW Annual AMP review and monitoring requirements, including AMP updates

ENGAGEMENT PLAN This section describes the approaches to be taken for First Nations and stakeholder engagement through all phases of the AMP: development, implementation, reporting and updating

Ongoing updates as more information is gathered

1.0 Introduction

1.1 Purpose and scope of this guide

This document (the “Guide”) provides guidance to quartz mining applicants and licensees on how to develop and implement responsive and inclusive Adaptive Management Plans (AMPs). Specifically, the guide aims to define a consistent and transparent method to respond adaptively to changes in water quality and quantity over the lifecycle of a mining project.

The guide details the Government of Yukon’s recommendations for the surface water and groundwater related components of AMPs. Content in the guide applies to prospective or current quartz mining applicants and licensees that are permitted under the Waters Act and the Quartz Mining Act. Quartz mining and exploration applicants and licensees are encouraged to apply all components described in the guide. While the guide does not apply directly to the exploration stages of a mineral property, unless there is an AMP requirement, the applicants and licensees should begin to consider the expectations of the guide during the advanced exploration stage to ensure that sufficient information has been collected to prepare a Conceptual AMP by the time the project is submitted for assessment.

In addition to quartz mining applicants, proponents, and licensees, this document can be used by Yukon and First Nation governments and agencies, stakeholders, and the public to better understand how to design or review water-related AMPs.

Reconciliation and respectful, ongoing collaboration with First Nations is a priority for the Government of Yukon. Efforts are ongoing to work with affected First Nations that have traditional territory in Yukon to integrate Indigenous worldviews into environmental guidance. Reconciliation is an iterative, non-linear process, which involves relationship building, inclusion and challenging the dominance of Western views and approaches (Pete, Schneider, and O’Reilly, 2013). Where possible, potentially impacted First Nations should be informed and engaged by proponents, applicants and licensees throughout the development and implementation of an AMP, including development of Adaptive Management Initiatives (AMIs). This will support the development of culturally relevant plans, and support indigenization (the deliberate weaving of two knowledge systems) of environmental management plans.

Quartz mining projects are large, multi-disciplinary, and dynamic, with environmental conditions often changing over a mine’s lifecycle. Quartz mining projects in Yukon are designed to mitigate potential effects to the environment and anticipate uncertainties as much as possible. Adaptive management is meant to address uncertainties, improve and ensure culturally informed environmental management and minimize unintended impacts.

1.2 Regulatory context in Yukon

The Yukon Environmental and Socio-Economic Assessment Act (YESAA), Waters Act, Quartz Mining Act, Chapter 14 of the Yukon First Nation Final Agreements, and other relevant legislation developed by First Nations governments govern or specify the use of water in Yukon for mining activities.

Mining applicants and licensees are required to submit a project- specific AMP under their Water Licence (WL) administered by the Yukon Water Board (YWB) and under their Quartz Mining Licence (QML) administered by Energy, Mines and Resources (EMR).

The following guidance documents provide information on Water Licence requirements, including AMPs, for quartz mining projects:

- **“Type A and B Quartz Mining Undertakings Information Package for Applicants” (YWB, 2012)**
- **“Plan Requirement Guidance for Quartz Mining Projects” (YWB and YG, 2013)**

The YWB notes in the Water Licence information package that mining development often involves uncertainties, which can lead to impacts on the aquatic environment. Given this, the YWB requires that applicants and licensees submit an AMP to assist in guiding management decisions when unexpected changes occur in the performance of a project. Similarly, EMR’s guidance for Quartz mining projects advises mining projects to design their AMPs to address unexpected project performance and how these effects could impact not only water, but also physical stability, wildlife and air. While these components are outside the scope of the guide, they are part of a comprehensive site AMP that is required to meet regulatory requirements. AMPs are meant to address uncertainty, but are not to be the basis for the management of the project. To be effective, the AMP will be based on the Monitoring and Reporting Plan required by YWB and EMR for quartz mining undertakings. Once the AMP is implemented, revisions to the Monitoring and Reporting Plan may be required.

During operation, AMPs are critical tools for licensees, regulators, compliance/enforcement officials and First Nations to ensure environmental conditions and issues are adequately managed. This tool is essential and should be applied to a point in time where any potential for liability has been settled. AMPs are particularly important for providing the flexibility in environmental management necessary for the evolutionary nature of a mining project. Government regulatory and compliance and enforcement officials apply AMPs to assist in differentiating between environmental management issues and compliance issues related to mine licences. AMPs are expected to be updated on a regular basis as the understanding of the environmental conditions and uncertainties of the site evolve. Revised AMPs must be submitted to YWB and EMR at frequencies defined by the license conditions. If required, at the time of licensing, the YWB will determine, on a case by case basis, how an updated AMP which has been submitted after the issuance of a water licence will be reviewed and approved. During closure and post-closure, AMPs are important as they aid in implementing successful reclamation plans and meeting closure goals, including the restoration of traditional land uses.

Figure 1 displays when the ‘Conceptual’ AMP, ‘comprehensive’ AMPs and AMP updates are expected during the mine lifecycle. Conceptual and comprehensive level AMPs are explained in more detail in Section 2.

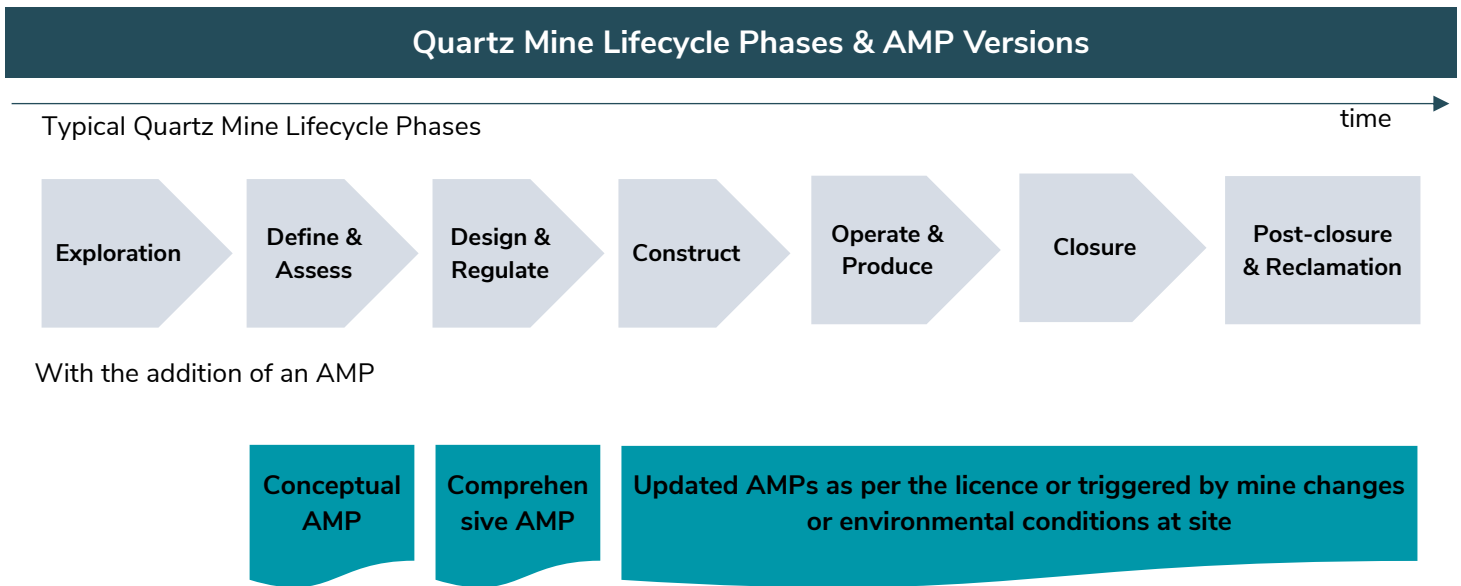


Figure 1 A description of where AMP development fits in the mine lifecycle process.

2.0 Adaptive management

2.1 Adaptive management theory

Adaptive management is a structured process of learning to reduce uncertainties and improve management over time. Adaptive management begins early in the project planning phase and continues throughout the project lifecycle (Williams et al. 2009). The best management option is implemented and its outcomes are monitored to evaluate if the objective was met. The results of the monitoring and evaluation is used to update knowledge, reduce uncertainty, and adjust management actions when appropriate. The adaptive management process is defined at the outset of a project in advance of any actions being taken.

Adaptive management should be used as a precautionary measure in natural resource management. The process recognizes that there are often uncertainties in the scientific predictions of the potential environmental impacts of a project (Canada Ltée v Hudson, 2001 SCC 40). Adaptive management “responds to the difficulty, or impossibility, of predicting all the environmental consequences of a project on the basis of existing knowledge” and “permits projects with uncertain, yet potentially adverse environmental impacts to proceed based on flexible management strategies capable of adjusting to new information regarding adverse environmental impacts where sufficient information regarding those impacts and potential mitigation measures already exists” (Pembina Institute for Appropriate Development v. Canada, 2008 FC 302). Adaptive management enables appropriate actions to deal with the unpredicted issues when they arise. The need for adaptive management, and project specific AMPs, emerges from the risk of potential environmental effects. Uncertainty about project component performance or possible unexpected negative environmental conditions needs to be identified as part of AMP development.

2.2 Adaptive management plans

Adaptive management plans are applied to projects and specific project elements. An AMP is a management tool that provides a consistent and pre-planned approach for understanding and responding to deviations in project performance or unforeseen environmental conditions. Such approaches can support timely and efficient decision making while providing regulators, First Nations, and stakeholders assurance that a consistent approach will be followed should an unexpected situation arise.

Many of the environmental conditions that may be encountered in quartz mining projects are unknown. As such, an AMP does not provide detailed descriptions of specific management responses but rather provides the approach that will be taken to develop management responses. An AMP, and associated Management Response Plans (MRPs), can be seen as a “toolbox” of possible management responses that range in level of intervention (e.g. increased monitoring) or mitigation (e.g. water treatment).

There are three broad types of project uncertainty that are addressed with this AMP guide:

1. The quartz mining project does not perform as predicted.
 - **Example:** The amount of contaminants seeping from waste rock storage facilities is higher than predicted in the water quality model.
2. An unforeseen condition occurs.
 - **Example:** The natural conditions around the site have changed (e.g. the site receives more water than initially anticipated in the water balance model) or there is an unexpected impact from another use in the watershed (e.g. new placer mining activities have developed upstream of the site)
3. The timing and/or location of a predicted effect of the quartz mining project is unknown.
 - **Example:** A groundwater contamination plume is known and mitigation measures have been identified but there are uncertainties on where and when the plume will move and when/where the planned mitigations should be implemented.

Figure 2 presents the application of the adaptive management cycle to quartz mining projects and illustrates that if monitoring results trigger an action, a management response plan is initiated and implemented.

AMPs are not intended to be used if the risk of harm is too high (e.g. failing containment structure), when outcomes are difficult to control (e.g. if indicators being measured are impacted by a variety of factors), if there is already high certainty within the project design, or if it is not possible to respond in an appropriate timeframe necessary to prevent harm. For these situations, specific management or mitigation plans should be developed. Additionally, AMPs are not to be used to defer the need for additional data.

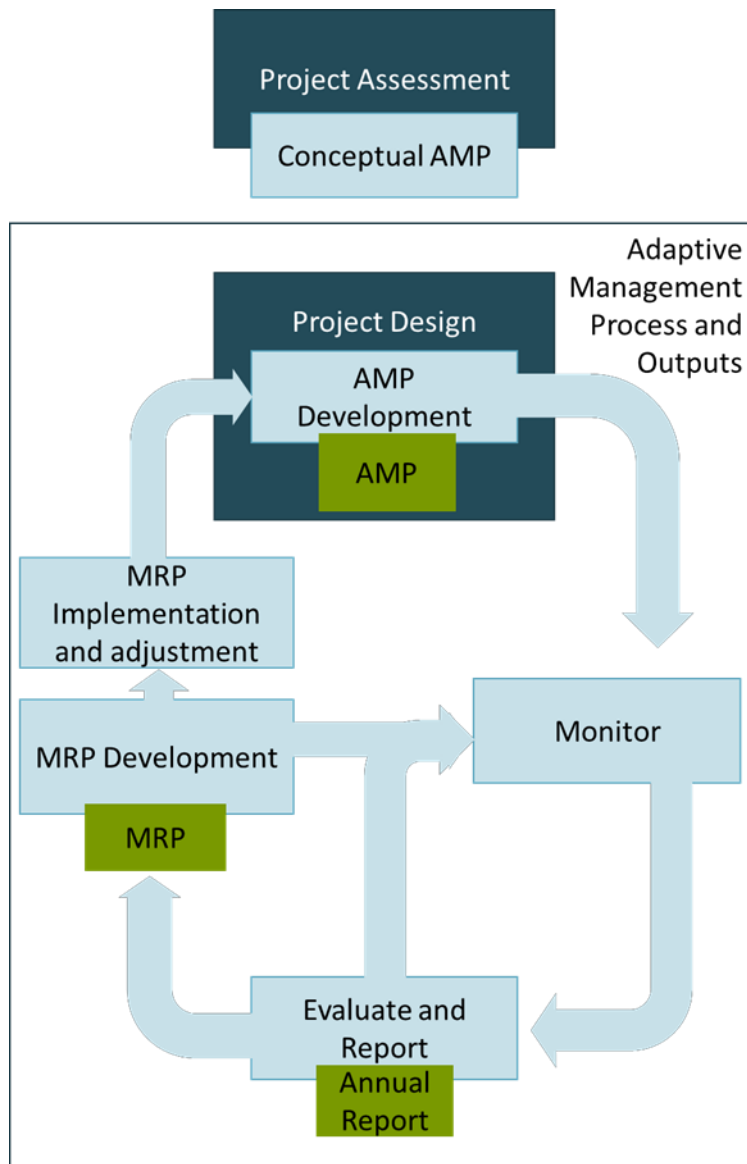


Figure 2 The AMP describes an approach that uses management response plans (MRPs) to develop, monitor, evaluate, report and adjust.

3.0 The AMP process and required components

There are three broad phases of AMPs, each with a different function in the AMP process. It is recommended that a Conceptual AMP (section 3.1) be submitted in a proponent's YESAA application for projects where potential impacts to water are being assessed. This applies to proposed new mines, the closure of an abandoned mine or an amendment or renewal of mining activities where the potential impacts to water are expected to change. A Conceptual AMP outlines a proponent's approach to adaptive management. It helps to demonstrate that proponents have considered the potential risks and uncertainties associated with the project. The second type of AMP, a Comprehensive AMP (section 3.2) is required for a proponent to obtain a QML and WL. These are rigorous and should include an overview of the mine site and specific descriptions of the AMIs, in order to assist in guiding management decisions when unexpected changes occur in the performance of a project. Comprehensive AMPs are living iterative documents that should be updated as the project evolves and more information is gathered. AMPs should be reviewed annually, and updated as needed (section 3.3). Finally, the AMP required for closure can either be included in the Comprehensive AMP or be presented in a stand-alone document. In this instance, the AMP may be referred to as a 'closure AMP'.

3.1 Conceptual adaptive management plans

Although AMPs are developed to support quartz mine and water use licensing, there is value in preparing and including a Conceptual AMP with a proponent's YESAA application. The Conceptual AMP should include, but may not be limited to, the following components:

- The proponent's approach to adaptive management;
- Potential project performance considerations and associated uncertainties; and
- Impacted First Nations' and stakeholder's environmental, cultural and socio- economic values as they relate to the project

Development of a Conceptual AMP should demonstrate to Yukon Environmental and Socio-economic Assessment Board assessors that a framework exists for adaptive management of potential mine-related residual effects to water and the receiving environment. This Conceptual AMP should, at a minimum, outline the proposed approach and scope for adaptive management at the site and should identify potential project performance issues and uncertainties that would be incorporated into the AMP, including identification of specific AMIs.

Providing this information as part of the assessment process will ensure that proponents have considered fully all the potential risks and uncertainties brought up during engagement, and if required, appropriate options for mitigation, as part of the Project Proposal.

3.2 Comprehensive adaptive management plans

The Comprehensive AMP provides details to guide management decisions arising from unexpected conditions and should provide confidence to Government of Yukon, First Nations rights holders and other stakeholders that the management of water will be appropriate over the life of the project.

As stated in Section 1, Comprehensive AMPs are expected as part of the application for a WL and a QML. The following subsections provide the reader with information on each component of the AMP. This includes the project context, the AMP approach, a detailed description of each AMI, AMP reporting and Engagement. Furthermore, Appendix 1 provides an example Table of Contents for a comprehensive AMP.

3.2.1 Project context

The first section of a comprehensive AMP will provide an overview of the mine site, Monitoring and Reporting plan, and regulatory context and where applicable, project history related to adaptive management. Linkages between the AMP and other relevant environment management programs, including the environmental monitoring program, should also be described.

3.2.2 AMP approach

This section will present the management goals and objectives of the AMP, along with an overview of the scope of the AMP and the expected timeline for implementation of the AMP. An overview of the key components of the AMP should be presented in this section, including engagement with First Nations.

3.2.3 List of AMIs

The AMIs covered in the AMP should be listed in this section. The selection of AMIs should be based on the applicant or licensees understanding of areas of uncertainty associated with the project and issues, concerns and uncertainties raised during the assessment and permitting processes, as well as any relevant terms and licence requirements. Where possible, AMI's should be developed in collaboration with potentially impacted First Nations, and could be informed by Traditional Knowledge to reflect community stewardship values around lands and resource integrity and health.

Rationale must be provided to support the selection of each AMI. Examples of AMIs include "XYZ Pit Water Level", 'water level in a XYZ pond', 'groundwater quality down gradient of XYZ waste rock dump'. Appendix 2 provides an example of AMPs for these three AMIs.

The following subsections described below should be presented for each individual AMI as per Figure 3.

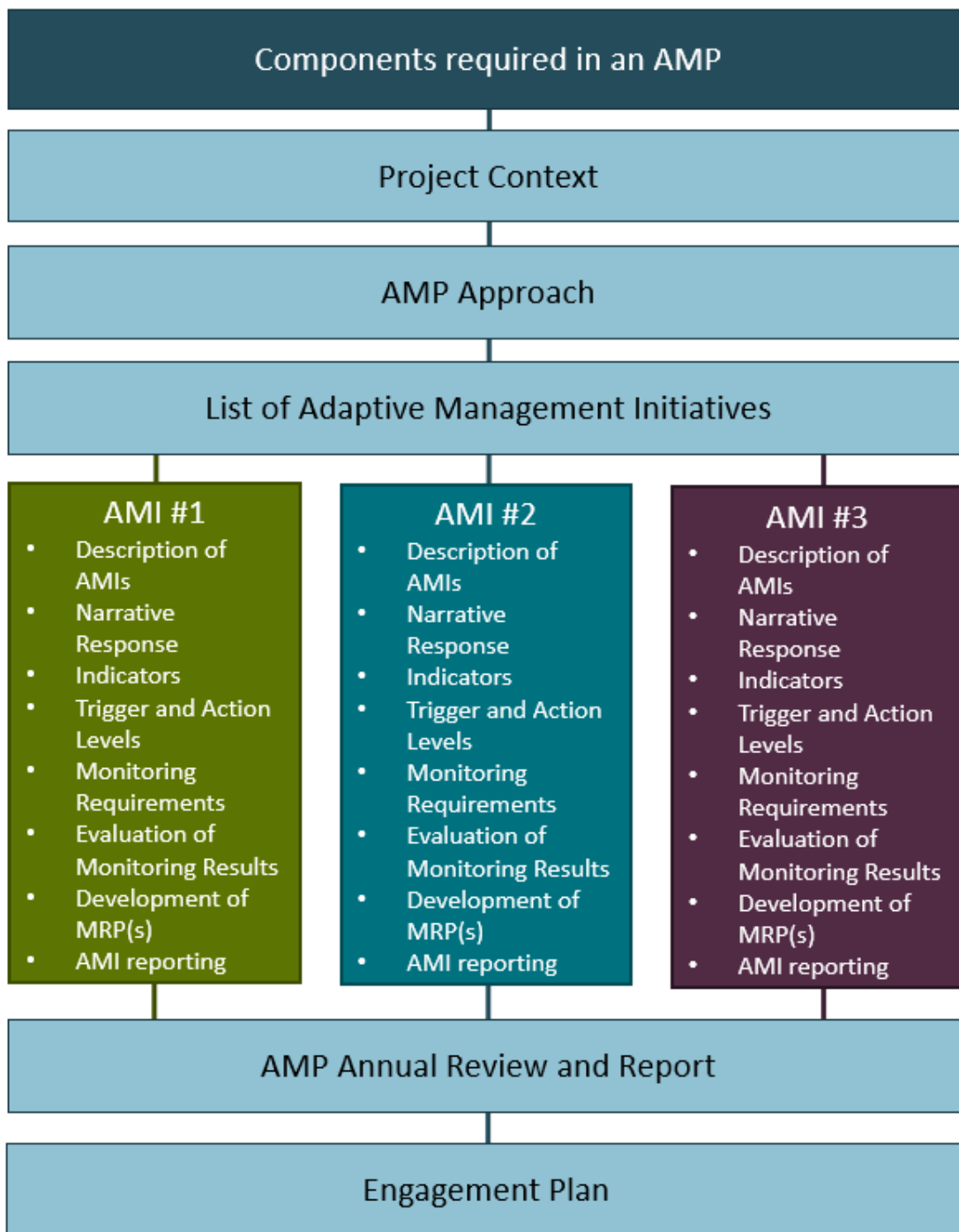


Figure 3 Expected contents of a comprehensive AMP.

3.2.3.1 Description of specific adaptive management initiatives

The specific event, performance uncertainty, or risk that is being addressed should be described for each individual AMI. Similar to the broader AMP process, specific management objectives should also be defined.

The environmental interactions and potential effects specific to this AMI should be summarized and a conceptual model should be presented in this section. It is recommended that the applicant or licensee use figures or illustrations to demonstrate the linkages between the specific project component(s) of concern and the aquatic environment. In addition, the potential environmental consequences of this event should be described i.e. what are the environmental consequences that would arise if the specific AMI was allowed to proceed without any response? Where possible, these descriptions should be developed with relevant First Nations.

A map showing monitoring station(s) relevant to the specific AMI and the key sources or project-related mine components should be included in this section of the AMP.

3.2.3.2 Narrative response

For each AMI, the trigger should be described qualitatively. This description should lead to the development of the specific indicators and thresholds.

3.2.3.3 Indicators

The applicant or licensee should identify indicators used to measure environmental conditions related to the risks and uncertainties identified. For each AMI, this section should describe the parameters or components to be monitored and assessed as part of the AMP. It is recommended that indicators and thresholds be developed with First Nations, where appropriate, to ensure cultural relevance. Indicators should meet the following criteria:

- Adequately characterize and/or measure the environmental condition that will potentially change
- Provide early detection of changes in environmental conditions or system performance
- Be representative of the issue being assessed and easily measurable, accurate and reproducible

Examples of indicators are concentrations of specific contaminants of concern or secondary indicator parameters, such as hardness, alkalinity or sulphate, which can be used to indicate the potential onset of acid rock drainage conditions. In other cases, indicators can be water level in a monitoring well or a pit or a mine waste management facility or it can be water discharge rate in a creek, a pipe or a ditch.

3.2.3.4 Triggers and action levels

In this section of the AMP, the conditions of the relevant indicator(s) and triggers, which will initiate a specific action or management response should be defined. The first step in defining triggers is establishing significance thresholds, which represent the onset of significant adverse effects in the valued aquatic ecosystem components (YWB, 2012). Significance thresholds should never be exceeded and are used as the basis for defining proactive AMP triggers to ensure they are not reached. More specifically, significance thresholds are based on environmental or cultural benchmarks or toxicity thresholds established for the project as it relates to water management on site or the aquatic receiving environment.

The significance thresholds for each indicator should be defined during the licencing stage, and be based on the information generated during the YESAA process with input from affected First Nations governments. When possible, the applicant or licensee should work collaboratively with First Nations governments and local communities to identify the thresholds at which an effect would be seen as significant by local communities, knowledge holders or First Nations people. Significance thresholds may be based on Western and/or Traditional Knowledge.

Following the establishment of the significance thresholds, co-informed triggers should be identified. The triggers indicate the onset or the development of an effect at levels below the significance threshold. These triggers will be used to initiate actions that will ensure that the significant effect is not seen.

For AMIs that relate to water quality, the significance thresholds should be derived with consideration of established Water Quality Objectives (WQO) for the project. Various methods exist to develop WQOs and the approach used to identify the significance threshold for water quality depends on the method that was used to establish the WQOs. This is complex and more information can be found in the *draft Yukon Guide for Developing Water Quality Objectives and Effluent Quality Standards for Quartz Mining Projects* about methods to develop WQOs. Additionally, Appendix 3 describes how to identify the significance thresholds based on WQOs for the various methods used. Finally, Appendix 4 provides examples of significance thresholds and triggers. For groundwater quality AMIs, significance thresholds should be developed based on modelled groundwater/surface water interactions and based on the significance threshold established for the corresponding surface water, unless there is a direct groundwater receptor or use (e.g. drinking water). In the absence of a groundwater model, the groundwater quality significance threshold will be equivalent to the corresponding threshold for surface water.

Triggers and action levels should be conservative to provide confidence that actions will be taken prior to an adverse effect to the environment occurring.” It is recommended that AMPs include establishment of three action levels when possible: Low, Moderate and High. Each action level is representative of an increasing level of severity and has a corresponding set of management actions or responses commensurate with the action level.

For each action level, the applicant or licensee defines the trigger(s) that will initiate a specific action or management response. Each sequential action level should be set to represent an increasing magnitude of change to provide advance warning of potential issues, and to allow sufficient time to develop and implement an MRP prior to the onset of adverse conditions. Triggers should be representative of changing environmental conditions. In all cases, the triggers at each action level must be set below the significance threshold to ensure action is taken well in advance and that the significance threshold is never met. Figure 4a and 4b illustrate the relationship between the significance thresholds, action levels and measured change in water quality and quantity. The black line represents hypothetical changes in water quality (4a) and water level (4b). The tiered action level trigger system ensures that environmental conditions do not approach the significance threshold.

Furthermore, it is expected that environmental conditions will improve as a result of the responses put in place and that indicators no longer trigger specific action levels. In this case, the response will be adjusted. Although the action levels are set sequentially, there might be cases where the Low and Medium action levels are triggered at the same time.

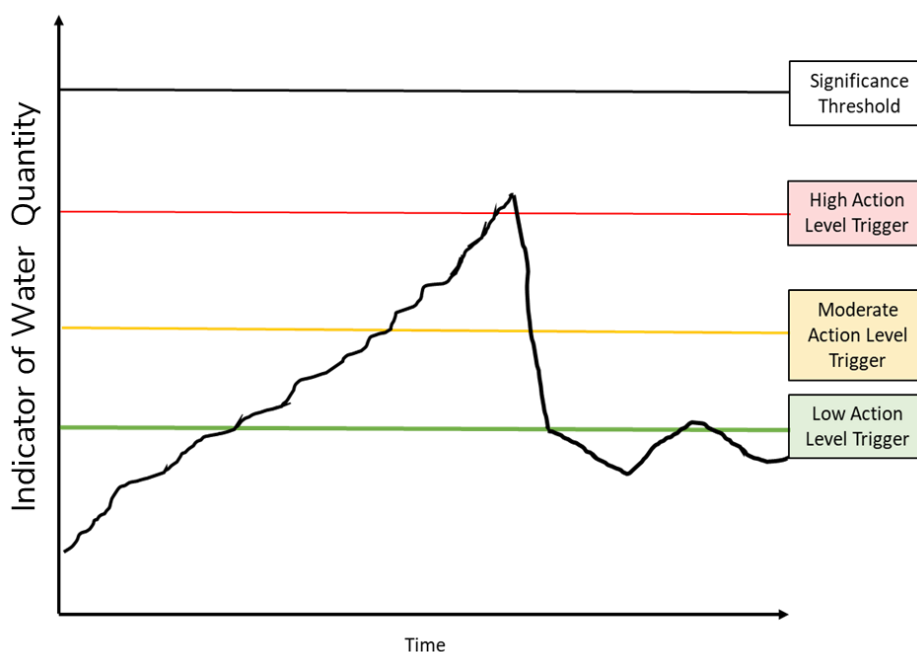
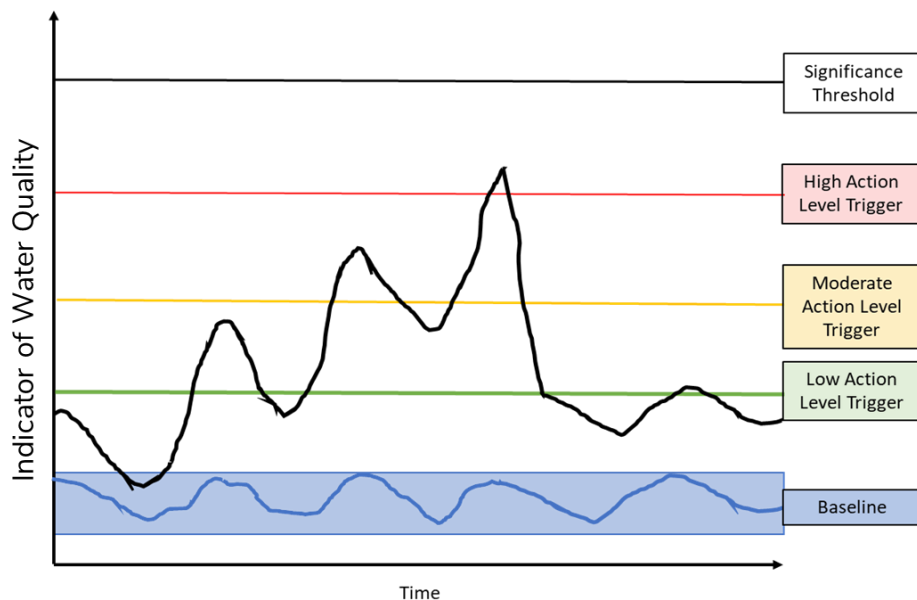


Figure 4a and 4b Example of relationship between significance threshold, action levels and triggers for water level/quantity.



Table 1 Description of Low, Moderate and High Action Levels

Action Level	Description
Low	<ul style="list-style-type: none"> Triggers are set well below the significance level and the high action level triggers. Data indicates deviation from predicted conditions and forward forecasting suggests potential ongoing change. Initiates MRP development which includes assessment and definition of the problem, identification of sources and identification of potential mitigative actions. For groundwater quality AMLs, triggers initiate development of groundwater model or revision of existing model.
Moderate	<ul style="list-style-type: none"> Triggers are set at levels that indicate that high action level trigger exceedance is possible within a specified time frame (such as 2 or 3 years). Should be both trend- and numerical-based. Initiates updates to the MRP to include evaluation of potential mitigative actions and identification and design of the preferred option to be implemented if the high action level is reached.
High	<ul style="list-style-type: none"> Triggers are typically set at a level indicating that the conditions are trending toward the significance level. Triggers can also be set as the maximum allowable level such as EQS or specific benchmarks identified during the licensing process that is protective of the receiving environment. Initiates immediate implementation of the mitigation identified in the MRP from moderate action level. Also initiates an update of the MRP to include monitoring of mitigation performance, identification and implementation of any required improvements. MRP may also include some degree of environmental remediation or restoration if required.

Triggers can be identified as either a threshold (a numerical value) and/or a trend. Threshold (numerical) triggers are selected values that when reached would trigger an action under the AMP. Trend-based triggers are based on data or information indicating an ongoing changing condition (such as an increasing trend) and are often based on statistical methods. They are as important as numerical thresholds in evaluating the need for a management response. It is recommended that both trend-based and numerical triggers be established.

The triggers may be based on the following, or a combination thereof:

- A statistical change from an existing baseline condition;
- A numerical value based on a percentile of a reference data set;



- A quantifiable change from expected performance;
- A numerical threshold based on predictive modelling, relevant guidelines or site-specific water quality objectives;
- A trend indicating increasing (or decreasing) levels of a specific indicator; or
- An increasing (or decreasing) trend of an indicator which will reach the next action level triggers within a specified period of time (“forward forecasting”).

There may be discrepancy between western knowledge and Traditional Knowledge perspectives when defining the Low, Medium and High action level triggers as both types of knowledge may have different sensitivities. If discrepancies arise, it is strongly recommended that they are discussed and settled through meaningful engagement. It is this level of inclusion and response that makes a management response plan meaningful in planning of mitigation measures for each project.

The time required for development, environmental assessment and/or licensing requirements, and implementation of an MRP, must be considered when developing the triggers. Where appropriate, forward forecasting trends should be used to provide advance warning of potential issues and requirements for mitigations. Specifically, low and moderate action levels should be based on a forward forecasting trend that predicts reaching the high action level within a specified timeframe. The specified timeframe should be based on timing required for investigation and assessment (completed after the low action level trigger is reached), design (completed after the moderate action level trigger is reached), environmental assessment and/or licensing requirements and implementation of any required mitigation. Where appropriate, the development of trend-based thresholds should consider seasonal variability.

Further details on statistical approaches to trend-based thresholds can be found in Wek’èezhii Land and Water Board’s *Guidelines for Adaptive Management – a Response Framework for Aquatic Effects* (2010).

For receiving water quality-based AMI and key contaminants of potential concern, it is recommended that at least one of the triggers be based on deviations from water quality model predictions. This will ensure that ongoing comparisons are made between actual and predicted system performance at key locations in the receiving environment. This will provide an opportunity to learn and refine the site water quality model as the project develops.

The applicant or licensee must provide supporting rationale for the derivation of each trigger with sufficient detail, such as statistical analysis, trend analysis or time series plots, to enable reviewers to evaluate the suitability and effectiveness of the proposed triggers. In addition, actual numerical values of the triggers for each indicator should be explicitly stated in the AMP, not just a reference to a specific guideline or standard.

It should be noted that if conditions change following initial development of the action level triggers, such as increasing rates of change of a specific indicator, it may be appropriate to revise the trend-based action level triggers. This would be done as part of the development or update of an MRP as well as through the annual review and update of the AMP.

3.2.3.5 Monitoring requirements

Monitoring is an essential component of any AMP. In this section, the applicant or licensee should describe the monitoring required to support the implementation of each AMI, with a focus on the environmental components that have been identified as indicators for a specific AMI. The description of the monitoring requirements for each AMI should be clearly summarized in this section, with reference to specific details provided as part of the site environmental monitoring plan. Where possible, First Nations should be included in monitoring programs through program design and/or community based monitoring programs. The level of detail provided should be sufficient to demonstrate that the proposed monitoring program is robust enough to assess changes as proposed in the AMP and to support investigation that may be required if the Low Action Level is triggered.

The following information should be provided for selected indicators for evaluation against the AMI triggers:

- Location of primary monitoring station(s)
- Indicators being monitored
- Frequency of monitoring

If the AMP is triggered, all monitoring data that will be used for analysis should be complemented with background data and site operation data. This could include upstream surface, groundwater, seepage and source water quality and flow data, water quality data from key background or reference monitoring locations, recent climatic and precipitation data. Site operation data could include water quality at various locations on site (effluent, pit, seepage at the toe of a pile or a dam), water levels in a mine, a pit or other facilities, treatment process performances, site conditions or other relevant information.

All relevant monitoring information such as methodology, accuracy and timeline for obtaining results should be defined within the site environmental monitoring plan. For some AMIs, the participation of community monitors might be required, especially in the AMI is informed by traditional or local knowledge.

3.2.3.6 Evaluation of monitoring results

Within the context of implementing the AMPs, there will be an ongoing need to analyze the monitoring results and determine if there was trigger activation. This evaluation process must be conducted in a timely manner and is necessary to verify that appropriate response actions are implemented if needed.

A detailed process should be described for each AMI to determine, validate and confirm that conditions are reaching or exceeding specific triggers. It is recommended that the process include the following elements:

- 1) Scheduled, reoccurring, and timely review of monitoring data and comparison to triggers



- Methods and timing for the comparison of data to triggers and identification of trigger activation should be described
 - i.e. manual comparison or through database management software
- Frequency of review should be tied to receipt of QA/QC'd laboratory results
 - i.e. within two weeks of receipt of results
- Company representative(s) responsible for monitoring data evaluation and reporting should be identified
- Some monitoring should occur continuously if the impact is high risk

2) Verification of monitoring results and confirmation of exceedance

- Comprehensive analysis of laboratory results and corresponding field notes should be presented
- Data analysis and confirmation of exceedance should occur in a timely fashion in order to respond to concerns
- Re-sampling or re-analysis may be warranted
 - i.e. quality assurance/quality control data or field notes indicate sampling issues or errors
 - timing of re-sampling should be specified

3) Analysis of other related monitoring data

The objective of this analysis is to provide for early indication of the cause of trigger activation

- Other related monitoring results from the locations identified in Monitoring Requirements should be reviewed and analysed
 - i.e. data from upstream or downstream locations in the watershed, data from point sources.
- Where applicable, the results collected for other associated AMIs should be included

4) Confirmation of threshold exceedance

Although presented in a sequential order, some steps may occur concurrently or may be eliminated, depending on the individual circumstances of a trigger activation. In all cases, the approach to AMP data evaluation must be one that expedites the process of reporting and responding to any trigger activation.

3.2.3.7 Development and Implementation of management response plans

In this section, applicant or licensee s are asked to describe their approach for management responses, including the development, update and/or implementation of MRPs, once a given action level trigger(s) is reached.



As discussed above, three action levels (Low, Moderate and High) should be established for each AMI. Each action level represents increasing levels of severity and has a corresponding set of management actions or responses commensurate with the action level reached. For example, the management response to a low action level may involve increased monitoring and investigation into the potential cause of the exceedance and identification of potential mitigative actions, while a response to a high action level may include the implementation of mitigation.

The approach to develop a MRP when a trigger is activated follows the components of the adaptive management cycle (Figure 2). The MRP will be developed as the Low and Moderate Action Level triggers are reached and implemented accordingly when the Moderate and High Action Level triggers are reached:

- Low Action Level – Assessment, characterization and definition of the problem
 - Preparation of preliminary MRP
- Moderate Action Level – Design of the mitigation measure(s) and potential implementation of early or interim response/mitigation
 - Update of the MRP with detailed design and planning for the implementation of the mitigation measure(s), possibly including assessment and permitting if required
- High Action Level – Implement, monitor, evaluate and adjust the response/mitigation
 - Implementation of MRP with on-going monitoring and reporting. If necessary, the MRP might be updated and the mitigation strategies adjusted

The MRP should include the identification of source(s), findings of past investigations, plans for further investigation, and an overview of the range of potential management/mitigation options that could be implemented should the indicated trend continue and reach the next action level trigger(s). MRPs should identify which mine personnel/consultants will be responsible for key decisions related to the development/update and implementation of MRPs. When possible and if timing allows, the preliminary and updated MRP should be co-developed by the Licensee with the affected First Nation(s).

Following confirmation of a low action level trigger exceedance, the implementation of responses should follow a staged approach based on action levels, starting with confirmation of causes at low action levels, followed by evaluation of mitigative options, and ending with the design and implementation of appropriate mitigative measures at high action levels. The degree of response and external involvement in the development and review of management actions and responses will depend on the severity of the action level (see [Table 2](#)).

Although in most situations the specific management responses will not be known in advance, the applicant or licensee should provide a “toolbox” of potential mitigations/management responses for each AMI that would be considered for implementation. This should include appropriate development of potential mitigations/management actions.

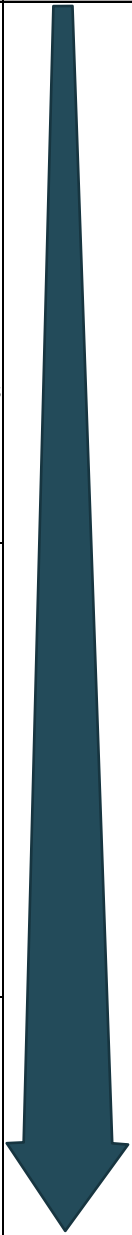
The suite of options presented should be suitable for the mine site conditions, technically feasible, and implementable in a timely way for the specific uncertainty or issue being addressed by the MRP. In addition, the potential mitigations provided in the “toolbox” should range in level of complexity and intervention.

Depending on the action level reached, the applicant or licensee might need to seek stakeholders input to develop the MRP (Table 2). At each action level, the corresponding MRP must be provided to. Inspections and distributed to stakeholders as per the AMP Stakeholder Engagement Plan. Section 3.4 provides guidance for stakeholder engagement in the AMP development process.

Finally, there may be cases where an investigation concludes that the environmental change which caused an AMP trigger for an applicant or licensee was not caused by the activities conducted by this applicant or licensee, but by external factors (natural or anthropogenic). In this case, the response might be redefined and include engagement with Yukon and affected First Nation government, local communities and other stakeholders, as needed, to identify an appropriate set of actions.



Table 2 Management Responses to Low, Moderate and High Action Levels. The level of stakeholder involvement during the action level should be determined by the type of AMI approach, whether from a western knowledge or a Traditional Knowledge approach, or combination of both. A low or moderate western knowledge action level may be identified at moderate or high from a Traditional Knowledge informed perspective. Related data that can inform potential trends and forecasting should be applied.

Action Level	Description of Management Response Plan Elements	Level of Stakeholder Involvement
Trigger Confirmed		
Low	Assess and Define the Problem <ul style="list-style-type: none"> • If required: <ul style="list-style-type: none"> ○ Increase monitoring activity, including number of parameters, frequency, and location, to improve understanding of the cause of the trigger activation ○ Undertake detailed field investigations to determine possible project- related causes ○ For groundwater: Develop detailed groundwater models and define Moderate and High Action Level triggers • Confirmation if the source is mine related • Preparation of preliminary MRP* including re-evaluation of timelines and possible adjustment of triggers to ensure timely implementation of MRP when required • Identification of mine personnel/consultants who will be responsible for key decisions related to the development/update and implementation of MRPs • Completion of updates to the MRP following conclusion of any additional investigations 	
Moderate	Design Preferred Option <ul style="list-style-type: none"> • Update the MRP to include a detailed assessment/evaluation of the mitigation options and selection of the preferred management response that will be implemented should the trend continue and high action level triggers be reached <ul style="list-style-type: none"> ○ The updated MRP should include the design of the selected option for mitigation in sufficient detail to allow for successful implementation should the high action level be reached, including any required assessment and permitting ○ The updated MRP should also include any proposed modification to the AMP, and associated monitoring that would be implemented to assess the effectiveness of the proposed intervention • Where appropriate, the MRP at this stage could include implementation of a response/mitigation that is intended to stabilize conditions and minimize ongoing deterioration or change. 	
High	Implement, Monitor, Evaluate and Adjust <ul style="list-style-type: none"> • Implement the preferred mitigative action to reverse the trend and improve environmental conditions • Continue monitoring and update the MRP to include any revisions or adjustments based on more recent information • Evaluate the effectiveness of the implementation of the management response • Adjust the MRP and AMP as needed 	



3.2.3.8 AMI reporting

As discussed in subsection 3.2.3.6, each AMI should include a review of the relevant monitoring data and the frequency of reporting on specific AMI updates should be based on the frequency of monitoring. Additionally, reporting in the corresponding monthly report to the YWB via Waterline should occur when a trigger has been activated and depending on the severity of the threshold reached, additional reporting may be done to Inspectors, regulators, right holders and/or other stakeholders as per the Engagement Plan (subsection 3.4). These triggers exceedance reports should include the results of the monitoring, analysis completed as part of trigger verification and outline the next steps to be taken with respect to the development of a MRP. Some AMIs include specific requirements for annual data evaluation; these reviews should be presented in the Annual Report and summarized as part of the AMP revision and update (subsection 3.3).

Where a trigger has been activated, notification should be provided to inspectors and distributed to regulators, First Nations and stakeholders as per the Engagement Plan (subsection 3.4). This notification should include the results of analysis completed as part of trigger verification and outline the next steps to be taken with respect to the development of a MRP.

3.3 AMP annual review, reporting and updating

The AMP is a living document, subject to updates as new information and data becomes available through the implementation of the AMP and related site monitoring programs. The logic and effectiveness of the AMP must be regularly re-evaluated as conditions at the site change and as knowledge of the site evolves. More specifically, periodic, comprehensive review of site data should be conducted to identify any new or changing conditions that were not previously considered; and the AMP approach should be revised periodically.

An annual review of the AMP should be completed to assess the adequacy and appropriateness of the elements of each AMI, such as triggers, indicators, trigger locations and monitoring requirements. It should also assess the need for any new AMIs.

Updates, amendments or changes to the AMP stemming from this review should be provided to inspectors and distributed to regulators, First Nations and stakeholders as per the Engagement Plan (subsection 3.5). While a revised AMP should be submitted to YWB at frequencies defined by license conditions, a report on the implementation of the AMP that includes triggered events, responses, AMP updates and engagement activities should be submitted as part of the annual report required under the QML and the WL.

In this section of the AMP, the applicant or licensee will describe the process and timeline for routine AMP reporting and the annual AMP review, consistent with the approach described above.

3.4 Consultation and engagement plan

First Nations place a high value on Yukon's water. Chapter 14 of the Final Agreements in Yukon (Water Management) specifies rights, and articulates the sustainable use of water by applicant or licensee and others. The objective of the chapter is "to maintain the water of the Yukon in a natural condition while providing for its sustainable use." For proposed or existing mines located within First Nations' Traditional Territories, consultation and relationship building between the applicant or licensee and the affected First Nations is a key component. Consultation, if required, should be undertaken based on Yukon First Nations Engagement & Consultation Guidebook, or based on specific First Nations guidance and policy around engagement and consultation. Communication with affected First Nations should begin early in AMP development and continue through all stages of AMP implementation, including MRP development, ongoing reviews and updates of the AMP. For more information on consultation and engagement, see the [Yukon First Nation Mineral Engagement & Consultation Tool](#) website, which includes a mobile app for the Mineral Exploration Industry.

The AMP development process should include engagement with Yukon and First Nations governments, local communities or other stakeholders and efforts should be made to co-develop the AMP, or part of the AMP, with affected First Nations. Table 2 outlines the level of stakeholder engagement and participation that should be set directly between the applicant or licensee and the relevant First Nations' community and relevant knowledge holders at the beginning of AMP development, identification of the AMI and is expected to advance as the action level triggers are reached and the MRPs are developed. Table 3 provides a summary of the minimum expected level of First Nation and stakeholder engagement for key phases of the AMP and its development.

An AMP Engagement Plan should be developed by the applicant or licensee, in collaboration with the relevant First Nation(s). The establishment of an AMP Technical Working Group, with representatives from the applicants, licensees, inspectors, government regulators, First Nations and key stakeholders is one method that could be used to facilitate consultation and engagement in the development, implementation, review and updating of the AMP. Table 3 describes potential consultation and engagement activities for each phase of the process.

Table 3 Potential consultation and engagement activities to be carried under the AMP

Phase	Description	Consultation and Engagement
YESAA Process	<ul style="list-style-type: none"> • Conceptual AMP submitted as part of YESAA Project Proposal • May lead to specific AMP requirements being defined in Decision Document 	<ul style="list-style-type: none"> • Review and input facilitated through the YESAA process • Uncertainties and issues raised during this phase should be incorporated in the development of specific AMIs
Licensing Process (QML/WL)	<ul style="list-style-type: none"> • A comprehensive AMP submitted as part of licence applications • Possible update of AMP may occur through technical/adequacy review processes • May lead to specific requirements in the QML and/or WL to submit an updated AMP 	<ul style="list-style-type: none"> • Engage with affected First Nations to seek input to define AMIs, significance thresholds and triggers. Co-develop some sections of the AMP when possible. • Review by all stakeholders and rights holders facilitated through the intervention/comment process
Post-Licensing - AMP Implementation	<ul style="list-style-type: none"> • Low Action Level Trigger Activation 	<ul style="list-style-type: none"> • Notice of trigger activation highlighted in monthly report via Waterline • Provide opportunity for inspectors, First Nations and stakeholders to provide input on preliminary MRP including input on the selected potential options for mitigation
	<ul style="list-style-type: none"> • Moderate Action Level Trigger Activation 	<ul style="list-style-type: none"> • Notification provided to inspectors, First Nations and stakeholders • Seek input from inspectors, First Nations and stakeholders on: <ul style="list-style-type: none"> ○ the selection process for the preferred option ○ the design of the preferred option ○ the updated MRP
	<ul style="list-style-type: none"> • High Action Level Trigger Activation 	<ul style="list-style-type: none"> • Notification provided to inspectors, First Nations and stakeholders • Seek input from inspectors, First Nations and stakeholders, possibly through the establishment of a working group on: <ul style="list-style-type: none"> ○ Review and input to any updates to the AMP ○ Review and input to AMP monitoring effectiveness of mitigation



Post-Licensing - AMP Annual Report and Update	<ul style="list-style-type: none">• Submission of AMP Implementation Annual Report and Updated AMP	<ul style="list-style-type: none">• Review of the AMP Annual Report• Provide opportunity for inspectors, First Nations and stakeholders to provide input on any recommendations stemming from the Annual Report, updates, amendments or changes to the AMP
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4.0 Modifications to AMP for abandoned sites or sites requiring staged mitigations

In some sites, such as abandoned sites with historic impacts to the environment, the source and/or the level of a contamination is known but the timing (and possibly locations) are unknown. In these cases, specific levels or stages of mitigation are already defined and the AMP is being used to trigger the implementation of the planned staged mitigations (as opposed to defining appropriate actions to deal with an unforeseen issues). For example, an historic mine component has led to the contamination of groundwater underneath. The plume of contamination has been mostly defined, the general direction of ground water flow is known but the rate of flow is unknown. In this case, a groundwater interception system may have been proposed as part of the mine closure project but the timing and specific location of the system has not been defined because of unknown rate of flow and precise ground water flow direction. The proposed mitigation measures (interception system in this example), for the most part, have already been assessed and permitted. In these instances, the AMP is used to initiate and revise the design of the staged mitigations however the definition of triggers and management responses should be adapted. [Table 4](#) presents a description of the low, medium and high triggers that may be used in the case where staged mitigations are needed.



Table 4 Description of Low, Moderate and High Action Levels for Staged Mitigations (bolded text highlight the adaptations specific to staged mitigations)

Action Level	Description of triggers and management response
Low	<ul style="list-style-type: none"> Proactive response, with triggers set well below the significance level and the high action level triggers. Data, predictions and forward forecasting suggest potential trends or ongoing change that will require future implementation of the planned next phase of mitigation. Initiates MRP development which include assessment and definition of the problem, identification of sources (of contamination?) and/or potential required investigations, assessment of ecological implications and confirmation of the planned next phase of mitigation approach.
Moderate	<ul style="list-style-type: none"> Trigger set at a value that indicates a high level action trigger exceedance is inevitable (e.g., within a specified time frame such as 2 or 3 years, where the time frame is defined by the time that would be required to plan and implement a solution) Trigger activation results in update of the MRP, which include: <ul style="list-style-type: none"> the finalization of the design for the planned next phase of mitigation if the high action level is reached, evaluation and incorporation of any required modifications, identification and implementation of time sensitive or critical path items updates to the AMP, and associated monitoring, that will be used to monitor the effectiveness of the planned next phase of mitigation
High	<ul style="list-style-type: none"> Trigger is typically set at maximum allowable level or benchmark that was identified during licensing. Trigger activation leads to immediate action, as outlined in the MRP, to ensure that the mitigation strategy is implemented well before the significance threshold is met Revisions of the AMP are required and should include: <ul style="list-style-type: none"> Monitoring of the effectiveness of the mitigation measures A new set of Low, Moderate and High Action level triggers to initiate actions and possible implementation of additional mitigations Possibility to decrease mitigation efforts if/when the conditions have improved and the mitigations in place are not needed anymore



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Appendix 1 – Sample AMP table of contents

1. Project Context
2. AMP Approach
 - 2.1. Objectives
 - 2.2. Adaptive Management Approach
 - 2.3. Descriptive Overview of Adaptive Management Initiatives (AMIs)
3. Adaptive Management Initiative (AMI) #1
 - 3.1. Description of Specific AMI
 - 3.2. Narrative Response
 - 3.3. Indicators
 - 3.4. Triggers and Action Levels
 - 3.5. Monitoring Requirements
 - 3.6. Evaluation of Monitoring Results
 - 3.7. Development of Management Response Plan
 - 3.8. AMI Reporting
4. Adaptive Management Initiative (AMI) #2
 - 4.1. Description of Specific AMI
 - 4.2. Narrative Response
 - 4.3. Indicators
 - 4.4. Triggers and Action Levels
 - 4.5. Monitoring Requirements
 - 4.6. Evaluation of Monitoring Results
 - 4.7. Development of Management Response Plan
 - 4.8. AMI Reporting
5. Adaptive Management Initiative (AMI) #3
 - 5.1. Description of Specific AMI
 - 5.2. Narrative Response
 - 5.3. Indicators
 - 5.4. Triggers and Action Levels
 - 5.5. Monitoring Requirements
 - 5.6. Evaluation of Monitoring Results
 - 5.7. Development of Management Response Plan
 - 5.8. AMI Reporting
6. Annual Reporting and Review
7. Engagement Plan

Appendix 2 – Examples of adaptive management initiatives

The key components of the framework are illustrated below through the use of the following hypothetical AMI examples. These examples are provided as examples only to help the reader in understanding or developing an AMP for the protection of water resources. However, mine sites are extremely complex and there is not a one size fit all. Each sites has specificity that may require deviation from the specific examples provided below.

2.1 Adaptive management initiative (AMI) example 1 – xyz pit water level

2.1.1 Description of specific AMI

The current water balance for XYZ Pit predicts that there will be minimal accumulation of water in XYZ Pit after cessation of mining activities in the pit. Uncertainties with the pit water balance were raised during the assessment and permitting processes due to the lack of long-term baseline groundwater data in the vicinity of the pit. Specifically, concerns were raised that there is a risk that water will accumulate in the pit during operations. Water quality predictions indicate there is a risk that this water will be non-compliant and therefore could not be able directly released into the receiving environment if it was required. The site water management plan currently does not include any requirement for ongoing management of water in XYZ pit. There is the risk that the water level in XYZ pit could increase to a level that could require active management to ensure water levels are maintained below the maximum recommended water level elevation and to prevent discharge into the receiving environment. The spill elevation of the pit is 1216 masl and the maximum recommended water level elevation to provide adequate storage for unforeseen events is 1213 masl.

The environmental consequence of the water level in XYZ Pit reaching the spill elevation is the release of non-compliant water into the receiving environment. This could result in the exposure of aquatic resources to increased levels of contaminants in XYZ Creek.

2.1.1 Narrative response

The water level elevation in XYZ Pit reaches a maximum recommended water level which would require the implementation of active water management.

2.1.2 Indicators

The specific indicators that would be monitored to provide the information necessary to assess whether a trigger has been activated are:

- pit water level elevation; and
- projected time frame to maximum recommended pit water level elevation. (high action level trigger)

Supplementary monitoring information regarding pit lake water chemistry would be beneficial to track as well in the event that intervention is required.

2.1.3 Trigger and action levels

The significance threshold for the XYZ Pit Adaptive Management Initiative (AMI) is the maximum allowable water level elevation of 1216 masl. This is the elevation above which discharge out of the pit could occur.

This maximum allowable elevation was then used to determine the low, moderate and high action level triggers presented in Table 1. The time required for the assessment of options, design, permitting, construction and implementation of any required mitigation has been incorporated in to the selection of the triggers.

Table 5 Description of Low, Moderate and High Action Levels

Action Level	Triggers	Rationale
Low	<ul style="list-style-type: none"> • 1208 masl or • Increasing trend in water level that is predicted to reach the high action level trigger elevation of 1213 masl in 4 years 	<ul style="list-style-type: none"> • This elevation was back-calculated based on the conservative estimated rate of fill of 15 L/s • Estimated to be reached 4 years prior to reaching the high action trigger level • This will trigger investigation into the cause of the increasing water level and identification of potential mitigative actions
Moderate	<ul style="list-style-type: none"> • 1210 masl or • Increasing trend in water level that is predicted to reach the high action level trigger elevation of 1213 masl in 2 years 	<ul style="list-style-type: none"> • This elevation was back-calculated to provide a preparatory time frame of 2 years to reach the high trigger level based on the conservative estimated rate of fill of 15 L/s. • This time frame was selected to provide sufficient time for the selection of preferred option, design and permitting.
High	<ul style="list-style-type: none"> • 1213 masl 	<ul style="list-style-type: none"> • This is the maximum recommended water level elevation which will provide for 100% storage of the 1:100 wet year annual precipitation and still remain below the significance threshold



2.1.4 Monitoring requirements

The monitoring data that is required for this AMI is XYZ Pit water elevation data and local precipitation data. Pit water elevation data, collected as part of the routine monitoring program, includes continuous readings using a logger as well as monthly readings via direct water level survey measurements. The local precipitation data will be provided from the site meteorological station and will be used to assess pit filling projections.

Supplemental monitoring information regarding pit lake water quality will also be tracked in the event that future water treatment of pit water may be required in response to trigger activation.

2.1.5 Evaluation of monitoring results

AMP review of the pit water level elevation will be carried out on a monthly basis. This evaluation will include a comparison of the actual pit water level elevations to the AMI numerical threshold values. In addition, trend analysis will be carried out quarterly to predict when the maximum recommended water level elevation of 1213 will be reached.

Once an action level trigger has been reached, verification of the monitoring data will be carried out. This will include re-surveying the pit elevation and will be carried out within 2 weeks of initial indication of trigger activation.

The pit filling projections will also be prepared and reviewed annually as part of the annual AMP Report. This will include an evaluation of the previous years water balance inputs including precipitation, runoff, groundwater, evaporation, and managed inflows and outflows and update to the overall pit water balance.

Upon verification that a trigger has been reached, Government of Yukon Inspections will be notified in writing of the specific circumstances of the trigger activation and the next steps to be taken with respect to Management Response Plan development.

2.1.6 Development and implementation of management response plan development

A staged response to increasing pit water elevations in XYZ Pit, corresponding to action level, will be implemented if an action level trigger is reached (Table 2).

Table 6 Staged Response to Trigger Activation

Action Level Trigger Confirmed	Description of Management Response Plan Elements
Low	<p>Assess and Define the Problem</p> <p>If required:</p> <ul style="list-style-type: none"> ○ Increase monitoring activity, including number of parameters, frequency, and location, to improve understanding of the cause of the trigger activation ○ Undertake detailed field investigations to determine possible project-related causes ○ For groundwater: Develop detailed groundwater models and define Moderate and High Action Level triggers • Confirmation that the source is mine related • Preparation of preliminary MRP* including re-evaluation of timelines and possible adjustment of triggers to ensure timely implementation of MRP when required • Identify of mine personnel/consultants who will be responsible for key decisions related to the development/update and implementation of MRPs • Complete updates to the MRP following conclusion of any additional investigations
Moderate	<p>Design Preferred Option</p> <ul style="list-style-type: none"> • Update the MRP* to include a detailed assessment/evaluation of the mitigation options and selection of the preferred management response that will be implemented should the trend continue and high action level triggers be reached. <ul style="list-style-type: none"> ○ The updated MRP should include the design of the selected option for mitigation in sufficient detail to allow for successful implementation should the high action level be reached, including any required assessment and permitting. ○ The updated MRP should also include any proposed modification to the AMP, and associated monitoring that would be implemented to assess the effectiveness of the proposed intervention. • Where appropriate, the MRP at this stage could include implementation of a response/mitigation that is intended to stabilize conditions and minimize ongoing deterioration or change.



Action Level Trigger	Description of Management Response Plan Elements
Confirmed	
High	Implement, Monitor, Evaluate and Adjust <ul style="list-style-type: none"> Implement the preferred mitigative action to reverse the trend and improve environmental conditions. Continue monitoring and update the MRP to include any revisions or adjustments based on more recent information Evaluate the effectiveness of the implementation of the management response. Adjust the MRP and AMP as needed

The following is a list of potential management/mitigation options for this AMI:

- Should pit water be suitable for discharge to the receiving environment, implementation of pumping system for direct release from the pit to XYZ Creek;
- Should pit water require treatment prior to discharge, design of pumping system to transfer pit water to the existing Mill Water Treatment Plant.

The use of in-situ pit treatment will also be evaluated as an option when the low action level trigger is reached, if water quality predictions indicate future treatment may be required. If shown to be a viable option, in-situ treatment pilot testing would be proposed in the preliminary MRP.

2.1.7 Reporting requirements

The results of the monthly AMI data reviews will be reported, when a trigger occurs as part of the monthly reports which will be submitted to the Water Board via Waterline as well as to Inspections and distributed to regulators, First Nations and stakeholders as per the AMP Stakeholder Engagement Plan. The pit filling projections will be prepared and reviewed annually as part of the annual AMP Report. This will also include an evaluation of the previous year's precipitation data and update to the overall pit water balance.

MRPs developed as part of the AMI will be provided to Inspections and distributed to regulators, First Nations and stakeholders as per the AMP Stakeholder Engagement Plan.

2.2 Adaptive management initiative (AMI) example 2 – xyz pit water level

2.2.1 Description of specific AMI

The upper portion of XYZ Creek is adjacent to the XYZ waste rock dump as shown in Figure 1. Water quality in XYZ Creek may be negatively affected by contaminated seepage and groundwater from the XYZ waste rock dump.



Geochemical test work on the XYZ waste rock dump source material indicates that, while the majority of the material being placed in the dump is non-acid generating, there is some rock that is potentially acid generating (PAG). The Waste Rock Management Plan includes special segregation procedures for the PAG material to minimize potential for acid generating and metal leaching conditions. Water quality predictions for XYZ Creek were based on the assumption that the PAG material would not contribute loading to XYZ Creek. Concerns were raised by interveners during assessment and permitting that there is the potential for seepage from this PAG material to discharge to XYZ Creek and pose an environmental risk to aquatic species in XYZ Creek.

The environmental consequence of seepage from the PAG material reaching XYZ Creek is the potential exposure of aquatic species and habitat to increased levels of contaminants. Zinc is the primary contaminant of concern for seepage from this material and sulphate is a secondary parameter of concern as it is an indicator of the onset of acid generating conditions.

Water quality in XYZ Creek down gradient of the XYZ waste rock dump is measured monthly, along with flow, at station L2 (Figure 1). Baseline water quality at station L2 has been collected since 2014, with a total of four years of pre-development baseline water quality data. Zinc concentrations in XYZ Creek are currently above the CCME guideline value of 0.03 mg/L and a Site-Specific Water Quality Objective (SSWQO) of 0.08 mg/L has been established for zinc in XYZ Creek using the Background Concentration Procedure (Use Protection). In support of the development of the SSWQO a comprehensive toxicity testing program was carried out and a zinc chronic toxicity benchmark of 0.12 mg/L was established for the site.

2.1.1 Narrative response

Contaminant concentrations in XYZ Creek down gradient of XYZ waste increase to levels beyond model projections, to concentrations that may impact aquatic species.

2.1.2 Indicators

The specific indicators that should be monitored at L2 to provide the necessary information to assess whether a trigger has been activated are:

- Total zinc;
- Sulphate.

2.1.3 Triggers and action levels

The predicted water quality in XYZ Creek down gradient of XYZ waste rock dump assumes a negligible contribution of loading from XYZ dump. As such, the water quality at station L2 is predicted to be within the range of natural baseline conditions. Toxicity testing was carried out to support the assessment and permitting processes and showed that at concentrations above 0.12 mg/L of zinc, chronic effects may start to occur to the most sensitive species, taking into account the anticipated hardness conditions in XYZ Creek.

The significance threshold for total zinc for the XYZ Creek AMI is 0.12 mg/L; should the creek exceed this concentration, there is the potential for chronic effects to occur.

This significance threshold was then used to determine the low, moderate and high action level triggers for zinc presented in Table 3.

Although zinc is the primary contaminant of concern, sulphate is a key indicator species for acid rock drainage (ARD) with increasing concentrations indicative of potential input of ARD.

Although a significance threshold has not been established for sulphate, action level triggers have been established to provide early indication of the onset of ARD conditions.

Table 7 Description of Low, Moderate and High Action Levels

Action Level	Triggers	Rationale
Low	<ul style="list-style-type: none"> • Total Zinc <ul style="list-style-type: none"> ○ Trend towards exceedance of SSWQO of 0.08 in 4 years ○ Numerical threshold based on SSWQO-BCP attainment: > 2 of 20 samples > 85th percentile of the baseline data set and 12-month rolling average > 85% Upper Confidence Limit Mean (UCLM) of the baseline data • Sulphate: <ul style="list-style-type: none"> ○ 30 mg/L in two consecutive samples ○ Increasing trend in winter (November to April) base flow sulphate concentrations 	<ul style="list-style-type: none"> • Numerical threshold value based on an approach consistent with the determination of SSWQO attainment • Reaching the low action level trigger would indicate concentrations are starting to increase to levels that indicate a potential future exceedance of the SSWQO • Trend-based threshold for total zinc was used to provide early warning of potentially reaching the high action level trigger • Sulphate is used as an indicator of onset of ARD conditions • Threshold value is based on the 95th percentile of the baseline data set • Trend based on winter low flow sulphate concentrations will pick up changes due to seepage and/or groundwater contributions that would otherwise be masked in open water conditions
Moderate	<ul style="list-style-type: none"> • Total Zinc <ul style="list-style-type: none"> ○ Trend towards exceedance of SSWQO of 0.08 in 2 years ○ Numerical threshold based on SSWQO-BCP attainment: > 2 of 20 samples > 90th percentile of the baseline data set and 12-month rolling average > 90% 	<ul style="list-style-type: none"> • Threshold value was selected as this value would indicate concentrations are increasing towards the high action level trigger • Trend-based threshold for total zinc was used to provide proactive early warning of potentially reaching the high action level trigger • 2-year time period chosen as to allow for sufficient time for assessment, selection and design of potential mitigation



	Upper Confidence Limit Mean (UCLM) of the baseline data <ul style="list-style-type: none"> • Sulphate: <ul style="list-style-type: none"> ○ Continued increasing trend in winter base flow sulphate concentrations 	
High	<ul style="list-style-type: none"> • Numerical threshold based on SSWQO-BCP attainment: > 2 of 20 samples > 95th percentile of the baseline data set and 12- month rolling average > 95% Upper Confidence Limit Mean (UCLM) of the baseline data 	<ul style="list-style-type: none"> • This value is based on non-attainment of the SSWQO • Reaching this concentration will trigger the implementation of mitigation to ensure the significance threshold of 0.12 mg/l is never reached and to bring the zinc concentrations in XYZ Creek to concentrations that meet the SSWQO

2.1.4 Monitoring requirements

The monitoring information required for this AMI is monthly total and dissolved zinc and sulphate concentrations as measured at station L2 in XYZ Creek. This data will be used for direct comparison to the specific thresholds and for trend analysis and forward forecasting projections.

Additional monitoring data that is required for analysis should the XYZ Creek AMI triggers be reached are subsurface and surface water quality and flow data from locations upstream of L2 as well as flow data from station L2. These locations are shown in Figure 1 and include upstream surface water quality station in XYZ creek, surface seepage monitoring locations from the waste rock dumps, and groundwater monitoring wells located at the toe of the rock dump. Both water quality and flow data are required as they enable not only the analysis of contaminant concentrations, but loadings as well. This data is collected as part of the routine monitoring program outlined in the Environmental Monitoring, Surveillance and Reporting Plan.

2.1.5 Evaluation of monitoring results

AMP review of L2 water quality data will be carried out on a monthly basis when the QA/QCed data is received from the laboratory. The typical laboratory turn-around time for standard analysis is two weeks. This evaluation will include a comparison of the most recent water quality data to the AMI numerical threshold values and the trend analysis/projections will be carried out.

Once it has been identified that an action level trigger has been reached, verification of the monitoring data will be carried out. This will include a comprehensive analysis of the laboratory results and corresponding field notes and site operational reports. The water quality at L2 may then require re-sampling if warranted: if QA/QC data or field notes indicate that sampling issues or errors. This re-sampling will be done within one week from initial trigger activation.



The site load and water balance model will be reviewed and updated annually as per the site water licence and will also be included in the annual AMP report.

Upon verification of the monitoring data that a trigger has been reached, Government of Yukon Inspections will be notified in writing of the specific circumstances of the trigger activation and the next steps to be taken with respect to Management Response Plan development.

2.1.6 Development and implementation of management response plan development

A staged response to degraded water quality in XYZ Creek, corresponding to action level, will be implemented if an action level trigger is reached (Table 4).

Table 8 Staged Response to Trigger Activation

Action Level Trigger Confirmed	Description of Management Response Plan Elements
Low	<p>Assess and Define the Problem</p> <ul style="list-style-type: none"> • If required: <ul style="list-style-type: none"> ○ Increase monitoring activity, including number of parameters, frequency, and location, to improve understanding of the cause of the trigger activation ○ Undertake detailed field investigations to determine possible project-related causes ○ For groundwater: Develop detailed groundwater models and define Moderate and High Action Level triggers • Confirmation that the source is mine related • Preparation of preliminary MRP* including re-evaluation of timelines and possible adjustment of triggers to ensure timely implementation of MRP when required • Identify of mine personnel/consultants who will be responsible for key decisions related to the development/update and implementation of MRPs • Complete updates to the MRP following conclusion of any additional investigations



Action Level Trigger Confirmed	Description of Management Response Plan Elements
Moderate	Design Preferred Option <ul style="list-style-type: none"> Update the MRP* to include a detailed assessment/evaluation of the mitigation options and selection of the preferred management response that will be implemented should the trend continue and high action level triggers be reached. <ul style="list-style-type: none"> The updated MRP should include the design of the selected option for mitigation in sufficient detail to allow for successful implementation should the high action level be reached, including any required assessment and permitting. The updated MRP should also include any proposed modification to the AMP, and associated monitoring that would be implemented to assess the effectiveness of the proposed intervention. Where appropriate, the MRP at this stage could include implementation of a response/mitigation that is intended to stabilize conditions and minimize ongoing deterioration or change.
High	Implement, Monitor, Evaluate and Adjust <ul style="list-style-type: none"> Implement the preferred mitigative action to reverse the trend and improve environmental conditions. Continue monitoring and update the MRP to include any revisions or adjustments based on more recent information Evaluate the effectiveness of the implementation of the management response. Adjust the MRP and AMP as needed

The following is a list of potential management/mitigation options for this AMI:

- Short-term mitigation measures to control migration from source may include ditching, berming and pumping back to pit of seepage drainage from XYZ waste rock dump;
- Modification of PAG waste rock management procedures to minimize placement in XYZ waste rock dump;
- Permanent surface and shallow seepage collection system near the toe of the waste rock dump that directs seepage to a collection sump where it can be pumped back to the pit; and
- Installation of a groundwater seepage interception system along the toe of the dump to collect groundwater and pump it back to the pit.

2.1.7 Reporting requirements

The results of the monthly AMI data reviews will be reported, when a trigger occurs, as part of the monthly reports which will be submitted to the Water Board via Waterline as well as to Inspections and distributed to regulators, First Nations and other stakeholders as per the AMP Stakeholder Engagement Plan.



A comprehensive assessment of the AMI related water quality, including trends, will also be carried out annually as part of the annual AMP report

MRPs developed as part of the AMI will be provided to Inspections and distributed to regulators, First Nations and other stakeholders as per the AMP Stakeholder Engagement Plan.

2.3 Adaptive management initiative (AMI) example 3 – groundwater quality down gradient of xyz waste rock dump

2.3.1 Description of specific AMI

The upper portion of XYZ Creek is adjacent to the XYZ waste rock dump as shown in Figure 1. Water quality in XYZ Creek may be negatively affected by groundwater from the XYZ waste rock dump. Geochemical test work on the XYZ waste rock dump source material indicates that, while the majority of the material being placed in the dump is non-acid generating, there is some rock that is potentially acid generating (PAG). The Waste Rock Management Plan includes special segregation procedures for the PAG material to minimize potential for acid generating and metal leaching conditions. Water quality predictions for XYZ Creek were based on the assumptions that the PAG material would not contribute to groundwater that ultimately discharges into to XYZ Creek. Concerns were raised by interveners during assessment and permitting that there is the potential for this PAG material to contaminate groundwater that ultimately discharges to XYZ Creek and pose an environmental risk to aquatic species in XYZ Creek.

The environmental consequence of groundwater with elevated metals and other ARD by-products reaching XYZ Creek is the potential exposure of aquatic species and habitat to increased levels of contaminants. Zinc is the primary contaminant of concern for seepage from this material and sulphate is a secondary parameter of concern as it is an indicator of the onset of acid generating conditions.

Groundwater quality down gradient of XYZ waste rock dump flowing towards XYZ Creek is measured quarterly at MW18-03 along with water level elevation (Figure 1). Baseline groundwater quality at MW18-03 has been collected since 2014, with a total of four years of pre-development baseline groundwater quality data. Baseline dissolved zinc concentrations, as characterized by the 95th percentile of the baseline data set, are 0.03 mg/L. Water from the area of MW2018-03 ultimately report to XYZ Creek which has a SSWQO of 0.08 mg/L for dissolved zinc. In support of the development of the SSWQO a comprehensive toxicity testing program was carried out and a zinc chronic toxicity benchmark of 0.12 mg/L was established for XYZ Creek.

2.1.1 Narrative response

Contaminant concentrations in groundwater down gradient of XYZ waste rock dump increase to levels above those predicted and to concentrations, that if discharge into XYZ Creek may impact aquatic species.

2.1.2 Indicators

The specific indicators that should be monitored at L2 to provide the necessary information to assess whether a trigger has been activated are:

- Dissolved zinc;
- Sulphate.

2.1.3 Triggers and action levels

The predicted water quality in XYZ Creek down gradient of XYZ waste rock dump assumes a negligible contribution of loading from XYZ dump. As such, the water quality groundwater down gradient of the dump (as measured at MW2018-03) is predicted to be within the range of natural baseline conditions. The significance threshold for total zinc for XYZ Creek is 0.12 mg/L. Should the creek reach this concentration, there is the potential for the onset of chronic effects in XYZ Creek. The action level triggers are to be selected to ensure that the significance threshold concentration is never reached. This significance threshold was then used to support the development the low action level triggers for dissolved zinc in groundwater down gradient of XYZ waste rock dump outlined in Table 5. In absence of a detailed groundwater model in this area, as per the Government of Yukon's *Yukon Guide for Developing Adaptive Management Plans for Quartz Mining Projects*, the corresponding surface water quality threshold is to be used.

Although zinc is the primary contaminant of concern, geochemical test work of XYZ waste rock material indicates that sulphate is a key indicator species for acid rock drainage (ARD) with increasing concentrations indicative of potential input of ARD. Although a significance threshold has not been established for sulphate, action level triggers have been established to provide early indication of the onset of ARD conditions.

The proposed Low Action Level Triggers are outlined in Table 5. As per Section 3.6 of the Government of Yukon's *Yukon Guide for Developing Adaptive Management Plans for Quartz Mining Projects*, triggers have only been defined for the Low Action Level and the Moderate and High Action Level Triggers will be defined as part of the Management Response Plan developed in response to a Low Action Level trigger exceedance.



Table 9 Description of Groundwater Quality Low, Moderate and High Action Levels

Action Level	Triggers	Rationale
Low	<ul style="list-style-type: none"> • Total Zinc <ul style="list-style-type: none"> ○ 3-year rolling average > 95th percentile of the baseline groundwater quality dataset (0.03 mg/L) ○ Increasing trend towards the concentrations at MW2108-03 reaching the SSWQO for dissolved zinc (0.08 mg/L) within three years/L • Sulphate: <ul style="list-style-type: none"> ○ 3-year rolling average > 95th percentile of the baseline groundwater quality dataset ○ Increasing trend in winter (November to April) base flow sulphate concentrations 	<ul style="list-style-type: none"> • Numerical threshold value based on the SSWQO in the receiving environment – XYZ Creek. • This value was selected as it would indicate concentrations are starting to increase to concentrations that indicated potential future exceedance of the SSWQO • Trend-based threshold for dissolved zinc was used to provide proactive early warning of potentially reaching the moderate and high action level triggers • Sulphate is used as an indicator of onset of ARD conditions
Moderate and High	<ul style="list-style-type: none"> • High action level based on modelling trends and timing to receiving environment and back-calculated based on receiving environment significance threshold 	<ul style="list-style-type: none"> • Moderate and High Action Level triggers will be developed based on modelling carried out as part of a response to the exceedance of the Low Action Level trigger • The actual threshold values will be a function of travel time to the receiving environment and back calculated to ensure that water quality in XYZ Creek never reaches the significance threshold of 0.12 mg/L and meet the proposed SSWQO of 0.8 mg/L.

2.1.4 Monitoring requirements

The monitoring information required for this AMI is quarterly dissolved zinc and sulphate concentrations as measured at MW2108-03. This data will be used for direct comparison to the specific thresholds and for trend analysis and forward forecasting projections.



Additional monitoring data that is required for analysis should the XYZ groundwater AML triggers be reached are seepage, groundwater and surface water quality and flow data from locations up gradient and down gradient of MS2018-03. These locations are shown in Figure 1 and include upstream surface water quality station in XYZ creek, surface seepage monitoring locations from the waste rock dumps, and groundwater monitoring wells located at the toe of the rock dump. Both water quality (surface and ground), surface water flow, and groundwater elevation data are required as they enable not only the analysis of contaminant concentrations, but also the groundwater flow regime. This data is collected as part of the routine monitoring program outlined in the Environmental Monitoring, Surveillance and Reporting Plan.

2.1.5 Evaluation of monitoring results

AMP review of groundwater quality data from MW2018-03 will be carried out on a quarterly basis when the QA/QC'd data is received from the laboratory. The typical laboratory turn-around time for standard analysis is two weeks. This evaluation will include a comparison of the most recent water quality data to the AML numerical threshold values and the trend analysis/projections will be carried out.

Once it has been identified that an action level trigger has been reached, verification of the monitoring data will be carried out. This will include a comprehensive analysis of the laboratory results and corresponding field notes and site operational reports. The groundwater quality at MW2018-03 may then require re-sampling if warranted: if QA/QC data or field notes indicate that sampling issues or errors. This re-sampling will be done within one week from initial trigger activation.

Upon verification of the monitoring data that a trigger has been reached, Government of Yukon Inspections will be notified in writing of the specific circumstances of the trigger activation and the next steps to be taken with respect to Management Response Plan development.

2.1.6 Approach to management response plan development

A staged response to degraded water quality in XYZ Creek, corresponding to action level, will be implemented if an action level trigger is reached (Table 6).



Table 10 Staged Response to Trigger Activation

Action Level Trigger Confirmed	Description of Management Response Plan Elements
Low	Assess and Define the Problem <ul style="list-style-type: none"> • If required: <ul style="list-style-type: none"> ○ Increase monitoring activity, including number of parameters, frequency, and location, to improve understanding of the cause of the trigger activation ○ Undertake detailed field investigations to determine possible project-related causes ○ For groundwater: Develop detailed groundwater models and define Moderate and High Action Level triggers • Confirmation that the source is mine related • Preparation of preliminary MRP* including re-evaluation of timelines and possible adjustment of triggers to ensure timely implementation of MRP when required • Identify of mine personnel/consultants who will be responsible for key decisions related to the development/update and implementation of MRPs • Complete updates to the MRP following conclusion of any additional investigations
Moderate	Design Preferred Option <ul style="list-style-type: none"> • Update the MRP* to include a detailed assessment/evaluation of the mitigation options and selection of the preferred management response that will be implemented should the trend continue and high action level triggers be reached. <ul style="list-style-type: none"> ○ The updated MRP should include the design of the selected option for mitigation in sufficient detail to allow for successful implementation should the high action level be reached, including any required assessment and permitting. ○ The updated MRP should also include any proposed modification to the AMP, and associated monitoring that would be implemented to assess the effectiveness of the proposed intervention. • Where appropriate, the MRP at this stage could include implementation of a response/mitigation that is intended to stabilize conditions and minimize ongoing deterioration or change.
High	Implement, Monitor, Evaluate and Adjust <ul style="list-style-type: none"> • Implement the preferred mitigative action to reverse the trend and improve environmental conditions. • Continue monitoring and update the MRP to include any revisions or adjustments based on more recent information • Evaluate the effectiveness of the implementation of the management response. • Adjust the MRP and AMP as needed



The following is a list of potential management/mitigation options for this AMI:

- Modification of PAG waste rock management procedures to minimize placement in XYZ waste rock dump and control seepage at source;
- Permanent surface and shallow seepage collection system near the toe of the waste rock dump that directs seepage to a collection sump where it can be pumped back to the pit; and
- Installation of a groundwater seepage interception system along the toe of the dump to collect groundwater and pump it back to the pit.

2.1.7 Reporting requirements

The results of the quarterly AMI data reviews will be reported, when a trigger occurs, as part of the monthly reports which will be submitted to the Water Board via Waterline as well as to Inspections and distributed to regulators, First Nations and other stakeholders as per the AMP Stakeholder Engagement Plan. A comprehensive assessment of the AMI related water quality, including trends, will also be carried out annually as part of the annual AMP report

MRPs developed as part of the AMI will be provided to Inspections and distributed to regulators, First Nations and other stakeholders as per the AMP Stakeholder Engagement Plan.



Appendix 3 – Definition of significance thresholds for water quality based on water quality objectives

The significance threshold for water quality should be based on WQOs; however, the definition of these significance thresholds depends on the method used to develop the WQOs. More information on the methods to develop WQOs can be found in the Yukon Guide for Developing Water Quality Objectives and Effluent Quality Standards for Quartz Mining Projects. The following table provides an insight on how the significance threshold can be established depending on how the WQOs were developed (generic or site-specific WQOs and Background Concentration Procedure, Recalculation Procedure, Water Effect Ratio and Resident Species Procedure). Please note that the significance threshold can be the same or different than the WQO, depending on the method used for developing the WQOs.

Table 11: Description of Surface Water Quality Significance Thresholds for Parameters with Water Quality Objectives

Adopted Water Quality Objective	Significance Threshold	Rationale
Generic Water Quality Guidelines	<ul style="list-style-type: none"> Dependent on type of generic water quality guideline – Type A or Type B Type A (Statistical Derivation) – Significance Threshold to be based on evaluation of Species Sensitivity Distribution (SSD) data for relevant species at site Type B (Lowest Endpoint Derivation) – Significance Threshold to be based on revised safety factors taking into consideration the safety factors and endpoints for critical studies used in deriving the guideline.¹¹ 	<ul style="list-style-type: none"> When this approach for establishment of WQO for a specific parameter is adopted, supporting toxicity test work or SSD data evaluation is not required.

¹¹ The selection of a suitable safety factor for defining the Significance Threshold will depend on the type of endpoint used for deriving the long-term guideline. Lower safety factors can be applied for the preferred endpoints identified in the CCME protocol for the derivation of water quality guidelines: Most appropriate ECx/ICx representing a low-effects threshold > EC15-25/IC15-25 > LOEC > MATC > nonlethal EC26-49/IC26-49 > nonlethal EC50/IC50 > LC50. Safety factors for significant thresholds should be no less than 10 where the critical study is an LC50



Adopted Water Quality Objective	Significance Threshold	Rationale
Use Protection - Site Specific Water Quality Objective (other than Background Concentration Procedure (BCP))	<ul style="list-style-type: none"> Significance Threshold is the Site Specific Water Quality Objective 	<ul style="list-style-type: none"> Development of SSWQO using methods other than BCP is based on supporting toxicity test work
Use Protection SSWQO - BCP	<ul style="list-style-type: none"> Significance Threshold is the Toxicity Testing Effects Level 	<ul style="list-style-type: none"> Relying on BCP for use-protection does not evaluate potential for effects. Toxicity testing is needed to identify effects- based significance threshold.
Non-Degradation SSWQO	<ul style="list-style-type: none"> Significance Threshold is the SSWQO for non-degradation/background concentration procedure 	<ul style="list-style-type: none"> For waters with non-degradation SSWQO, the water quality is to remain relatively unchanged Meeting the non-degradation SSWQO will be based on the following attainment (Government of Yukon, 2019): <ul style="list-style-type: none"> > 2 of 20 samples > 95th percentile of the baseline data set Mean > 95% One Tailed Upper Confidence Limit Mean (UCLM) of the baseline data set



Appendix 4 – Examples of action level triggers for water quality in the receiving environment

Action level triggers are based on the significance thresholds, which are themselves based on WQOs. The following table provides examples of action level triggers that can be used as Low Medium and High triggers, depending on how the WQO were established.

Table 12: Description of Example Surface Water Quality Significance Thresholds and Action Levels

Adopted Water Quality Objective	Significance Threshold	Low Action Level	Moderate Action Level	High Action Level
Generic Water Quality Guidelines	Dependent on type of generic water quality guideline – Type A or Type B (Table 1)	<ul style="list-style-type: none"> Trend towards meeting WQG in specified period of time (e.g. 4 years) Numerical threshold based on WQG (e.g. 80% of WQG) Deviation from predicted performance 	<ul style="list-style-type: none"> Trend towards meeting WQG in specified period of time (e.g. 2 years) Numerical threshold based on WQG (e.g. 90% of WQG) Deviation from predicted performance 	<ul style="list-style-type: none"> Generic Water Quality Guideline
Use Protection-Site Specific Water Quality Objective (other than BCP)	Site Specific Water Quality Objective	<ul style="list-style-type: none"> Trend towards meeting SSWQO in specified period of time (e.g. 4 years) Numerical threshold based on SSWQO (e.g. 75%) Deviation from predicted performance 	<ul style="list-style-type: none"> Trend towards meeting SSWQO in specified period of time (e.g. 2 years) Numerical threshold based on SSWQO (e.g. 90%) Deviation from predicted performance 	<ul style="list-style-type: none"> Trend towards meeting SSWQO in specified period of time (e.g. 1 year) Numerical threshold based on SSWQO (e.g. 95%) Deviation from predicted performance



Adopted Water Quality Objective	Significance Threshold	Low Action Level	Moderate Action Level	High Action Level
Use Protection SSWQO - BCP	Toxicity Testing Effects Level	<ul style="list-style-type: none"> Trend towards meeting SSWQO in specified period of time (e.g. 4 years) Numerical threshold based on SSWQO-BCP attainment (e.g. 85th percentile) 	<ul style="list-style-type: none"> Trend towards meeting SSWQO in specified period of time (e.g. 2 years) Numerical threshold based on SSWQO-BCP attainment (e.g. 90th percentile) 	<ul style="list-style-type: none"> SSWQO – BCP attainment² <ul style="list-style-type: none"> > 2 of 20 samples > 95th percentile of the baseline data set Mean > 95% Upper Confidence Limit Mean (UCLM) of the baseline data set



Appendix 5 – Examples of action level triggers for groundwater

Table 13 Action Triggers for Groundwater

Action Level	Low	Moderate	High
Examples of groundwater triggers	Unexpected trend % deviation from predicted (if available) or baseline	Moderate action level based on modelling trends and timing to receiving environment and back-calculated based on receiving environment significance threshold	High action level based on modelling trends and timing to receiving environment and back-calculated based on receiving environment significance threshold



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